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IN CASE OF REPLY THE NUMBER AND DATE OF THIS LETTER SHOULD BE QUOTED

Our Ref. No. CF-18(b)

Your Ref. No. ____

CONFIDENTIAL:

EMBASSY OF GHANA
2139 R STREET, N.W.
WASHINGTON, D.C.

25th November, 1960

Sir:

I have the honour, on instructions of my Government, to transmit to you the enclosed despatches concerning the Volta River Project.

I have the honour to be,

Sir,

E. M. Debrah
Counsellor

DEPARTMENT OF STATE A/CDC/MR
REVIEWED BY A.S. DATE 14 MAY 1982
RDS☐or XDS☐EXT. DATE
TS AUTH. ____ REASON(S)
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Mr. S. Waugh,
Director and Chairman,
Export-Import Bank,
811 Vermont Avenue, N.W.,
Washington, D.C.

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NOV 29 1960
OFFICE OF THE PRESIDENT

EMD:np

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MINISTER OF FINANCE
P.O. BOX M.1
ACCRA, GHANA

11th November, 1960.

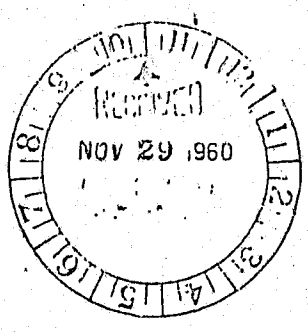
Dear Mr Waugh.

On the 3rd September, 1960, the United States Ambassador to Ghana, Mr. Wilson C. Flake, handed to the President of Ghana an Aide Memoire in which was expressed the willingness of the United States Government to make available to Ghana a loan of U.S. $30,000,000 on account of part of the cost of the Volta River Hydro-electric Project. Of this sum, U.S.$10,000,000 was to be provided by the Export-Import Bank for United States procurement at five and three-fourths per cent, while the balance would be made available by the Development Loan Fund, conditional on the submission of an appropriate application.

2. Accordingly, and acting on the direction of Osagyefo Dr. The Right Honourable Kwame Nkrumah, President of Ghana, I now have pleasure in submitting this application on behalf of the Government of Ghana.

3. This application seeks approval for funds amounting to U.S.$10,000,000 to be made available against United States procurement at interest of five and three-fourths per cent, for a total period of twenty five years, of which the first six would be a period of "grace" without amortisation; it is assumed that amortisation and interest would be paid in equated annual instalments over the remaining nineteen years.

/4.....



Mr. S. Waugh,
Director and Chairman,
Export-Import Bank,
WASHINGTON, D.C.

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4. The Project, as now planned, comprises in its first stage the construction of a dam, a saddle-dam and spillway, a power house, with all associated plant, services and equipment, and transmission lines. The main works will be at Akosombo on the river Volta and approximately 50 miles from its confluence with the sea; this is some 60 miles north-east of the new, modern, port of Tema. From here transmission lines will run to a main system control station at Tema town, and thence, on the one hand, to Accra, and, on the other, to an aluminum smelter with an estimated output of 140,000 tons of aluminum ingot per annum to be situated on the outskirts of Tema town. First class all-weather roads link Accra, Tema, and the dam site at Akosombo.

5. The first stage of the Project provides for a rated output of 512 Mw. continuous power, to be furnished by four turbo-generators of 128 Mw. capacity, rated for 15% continuous overload plus 5 % emergency overload.

6. The power-house, however, will provide for a total of six 128 Mw. units and expansion of the initial capacity by the addition of the fifth and sixth units has been planned to be at an additional cost of approximately U.S. $9,000,000 each, when demand justifies their installation.

7. It is also envisaged that an extended transmission system to carry power to the other towns and cities of Southern Ghana should be installed, but the precise timing and extent of this extension has not yet been finalised.

8. Outline plans have also been made for a further expansion of the capacity of the scheme by the addition, at Kpong, some five miles downstream from Akosombo, of a low-level generating station using the controlled tail waters of Akosombo and generating approximately 122 Mw. continuous power.

9. The capital costs estimated for the Project are approximately £G60,000,000 (equivalent U.S. $168,000,000) for the first stage, including interest on loans during construction, and contingencies at 20 % of construction

/cost .....

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cost, £G6,000,000 for the two additional turbo-generators, and approximately £G15,000,000 for the Kpong extension (this extension has not been accurately costed). The estimates for the first stage are given in more detail in the capital cost estimates prepared by Messrs. Kaiser Engineers and Constructors Inc., of Oakland, California, subsequent to detailed analysis and checking of first estimates by Messrs. Cooper Bros. and Company, of London, an internationally known firm of Chartered Accountants, which has much experience of work of this nature, including the complete costing and estimating of the Kariba Scheme in Southern Rhodesia. Copies of the estimates and of Messrs. Cooper Bros. report are attached as Annexures 'A' and 'B'. Your office already has copies of the detailed specifications and description of the Project, in the proposed Contract "A-3", which has been prepared for tender purposes.

10. It is planned that the construction contract should be let in April, 1961, and the contracts for supply of plant in due course afterwards.

11. The necessary financing of the first stage of the Project is now being arranged, and is to be as follows:-

A. Loans from abroad

(1) U.S. $10 m. @ 5 ¾% and 25 years; Ex-Im Bank;	£G3.56	million;
(2) U.S. $ 20 m. @ 3½% and 30 years; DLF;	£G7.14	million;
(3) £G5 m. @ 6% approx. and 25 years; U.K. Government	£G5	million;
(4) U.S. $40 m. @ 5 ¾% and 25 years; I.B.R.D.;	£G14.3	million;
TOTAL	£G30	million;

B. Ghana Government

The balance of £G30 million is to be provided in the form of an equity investment by the Ghana Government, and funds have been earmarked accordingly.

12. The cost of adding the fifth and sixth units is to be met from cash generated by the Project.

/13. The.

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13. The economic feasibility of the Project has been appraised by the World Bank, and this appraisal has been brought up to date in September 1960, in the light of the revised loan financing outlined above and of the now known rate of build up of smelter load and the price to be paid by the smelter (which is to be installed by a consortium of aluminum producers including Kaiser Aluminum, Reynolds Metals, Olin Mathieson, and perhaps others, to be known as the Volta Aluminum Company, Ltd., registered in Ghana). The Bank has been asked to make available to you copies of the revised appraisal as soon as possible. In the long term, and subject to variations in load growth, it is anticipated that the Project will:-

(a) Pay from generated cash a high proportion of the cost of future power requirements in Ghana;

(b) Pay to the Ghana Government a reasonable return on the equity capital invested in it and in ancillary works. This is presently estimated to be some 4½%. (If allocations for expansion are ignored, the return will be in the Vicinity of 7%.);

(c) Bring increased revenue to the Ghana Government from Company tax and personal income tax;

(d) Increase Ghana's overseas earnings by means of payments of the processing charges to the Smelter Company by the Company's foreign customers (the members of the Consortium).

14. It will be observed that I have used in the preceding paragraph the phrase "in the long term". In the first few years of operation the return on the investment is not good; this results from the need to build a large dam and power station capable of providing a continuous output far in excess of the anticipated demand for power in the initial years. As power demand grows (both in the smelter and in the non-smelter sectors) the return progressively improves, changing initial cash losses in the first two or three years to a surplus of about £1 million in the sixth year rising to about £3 million in the twelfth year, and increasing thereafter.

/15. I understand..

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15. I understand that it is desired to compare this Project with alternative means of achieving the same end, i.e. the generation by other means of an equivalent block of power. The only other practicable means of generating power in Ghana are thermal or atomic stations. In the former and cheaper case, thermal stations would be required to provide:-

(a) for Accra/Tema (excluding the Smelter) an installed capacity of 75 Mw. rising to 195 Mw. in 10 years at a capital cost of £12.3 million;

(b) Additional capacity at Takoradi for the Takoradi-Tarkwa-Kumasi area rising to an estimated 80 Mw. in ten years at a cost of approximately £8 million.

(c) A transmission net extending from Takoradi through Tarkwa to Kumasi at a cost of approximately £4 million. (On the Valid assumption that individual low output thermal stations are the most uneconomic to operate and should not be used.)

(d) A large thermal station in the Tema ar a to provide 315 Mw. peak power, 300 Mw. continuous power, to the aluminium smelter, at a cost of approximately £30 million (this estimate would not appreciably be decreased even if included in (a) above).

The total cost of this capacity would be approximately £54.3 million, and at best the unit cost of generation would amount to not less than 16 mills per Kwh, at prevailing average load factors, because of the high cost of fuel (which has to be imported), operation, and maintenance. (In practice, of course, no aluminium smelter would purchase power at such a price.) By comparison, the first stage of the Akosombo Project (which does not include the transmission net beyond Accra), based on estimated sales of 233.6 million KwH. to the transmission net and 578.2 million Kwh. to the smelter, interest and amortisation payments (including interest at 5 % on Ghana's investment of £G30 million) of £G3,956,000 and operating costs of £G620,000,

/total ....

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total £G4,576,000, provides power at a cost of 15.78 mills Kwh. in 1967. By the tenth year, however, the load will have grown to 3,231.7 million Kwh. and the cost will be 4.03 mills KwH, a marked reduction on the cost of generating thermal power.

16. If the full transmission system is added, the capital cost becomes £G70 million, (an increase of £G10 million) sales in 1967 would be 969.1 million KwH. overall, the amortisation and interest would be £G4.8 million (including 5 % on Ghana's equity) and operating costs of £G820,000; on this basis the cost of power would be 16.24 mills KwH. in the first year; by the fifth year, in 1971, sales would have risen to 3,318.7 million KwH. and the cost would then be 4.81 mills KwH. By 1976, the tenth year of operation, the sales would have risen to 3,732.5 million KwH, and the cost would be 4.34 mills. After the first few years of operation, therefore, the cost of power from the Volta Project, with or without the transmission system, is appreciably lower than that obtainable from alternative sources.

17. Additional benefits obtainable from the proposed project, the capital value of which it is not proposed to include in this comparison because of the difficulty of assessing these in terms of cash value, are set out below:-

(a) At present livestock is imported either from the north or from the east on hoof. Some 30,000 head of cattle, 48,000 sheep and 30,000 goats are moved on hoof, and, depending on the season, between 2 % and 18 % of live weight is lost, average losses being about 10 %; moreover, the animals' condition suffers. Movement of this livestock by water on the Volta Lake will much improve this wasteful method, both in terms of marketable weight and condition. Other uses of the lake as a waterway are also envisaged, particularly passenger traffic, and a potential movement of iron ore from deposits near Yendi to Akosombo for treatment in an iron ore smelter in the Tema area (when this method of smelting has been proved). Additional investment in terms of lake harbours, tugs, barges,

/and .....

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and passenger vessels will be necessary.

(b) The creation of a 3,500 square mile lake should, after the fifth or sixth year, provide a fish catch of up to 30,000 tons per annum. This potential catch is of the greatest value to Ghana, as the average diet is severely lacking in protein; additional capital investment would, however, be necessary.

18. Ancillary costs attributable to the Project, although not directly arising from it, amount to £G7.164 million. The detailed estimates from which this figure is obtained are attached at Annexure 'C'.

19. Of the capital cost of £G60 million, approximately £G11 million would be local expenditure, the balance being in foreign currency. It is not possible to give a detailed breakdown of the foreign currencies required, since it is not known yet to which country the contractors to be selected will belong.

20. It is, I understand, desired to show in what manner the Project will be operated. Briefly, it is intended to establish a Volta River Authority as a statutory authority, the board of which will consist of seven members appointed by the President, of whom one will be the Chief Executive of the Authority. A copy of the first draft of the Bill concerned is attached.

21. If this application receives the Bank's approval, it would be appreciated if you could indicate whether any further details are required, and whether the terms indicated in paragraph 3 above are acceptable.

Yours sincerely,

Hon. K. A. Gbedemah, Finance Minister

MINISTER OF FINANCE.

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ANNEXURE "A"

VOLTA RIVER PROJECT: CAPITAL COST ESTIMATES

The summary cost estimates below have been prepared by Messrs. Kaiser Engineers and Constructors, Inc., effective as at 1st. January 1961. The figures for contingencies and interest during construction have been calculated by the Volta River Project Secretariat.

		£'000
1.	Preliminary works before 1957, NOT included	(1,707)
2.	General Features:	
	(i) Compensation and Resettlement £3,500,000	
	(ii) Volta River Authority expenses £1,500,000	
	(iii) Health measures £1,241,000	
	Total general features	6,241
3.	Akosombo township and roads	4,000
4.	Akosombo dams and power plant, including escalation and engineering	33,540
5.	Contingencies @ 20% of civil works and 5% of supply items, in 3 and 4	5,232
6.	Total 2 through 5	49,013
7.	Transmission system Akosombo/Tema/Accra including escalation, engineering and contingencies	5,814
	TOTAL ESTIMATED COST - FIRST STAGE	54,827
8.	Interest during construction on loans only	4,325
9.	Working capital, including cover for initial losses	2,000
	TOTAL FUNDS REQUIRED - FIRST STAGE	61,152
10.	If full transmission network beyond Accra is required, the additional cost, including interest during construction, engineering and contingencies, is	7,990
11.	Additional working capital required	1,500
	TOTAL FUNDS REQUIRED FOR FULL SYSTEM - FIRST STAGE	70,642

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ANNEXURE 'B'

COPY

VOLTA RIVER PROJECT
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20 JUL 1960
SECRETARIAT

VOLTA RIVER PROJECT

REPORT DATED 3RD JUNE 1960

ON THE ESTIMATES OF THE COST OF THE WORKS AT AKOSOMBO

AND

THE GHANA TRANSMISSION SYSTEM

COOPER BROTHERS & CO.
CHARTERED ACCOUNTANTS

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VOLTA RIVER PROJECT

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VOLTA RIVER PROJECT

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COOPER BROTHERS & CO.
CHARTERED ACCOUNTANTS

BIRMINGHAM, GLASGOW, LEICESTER, LIVERPOOL, MANCHESTER, SHEFFIELD.

OVERSEAS
COOPER BROTHERS & CO. AND COOPERS & LYBRAND
UNITED STATES OF AMERICA, CANADA, MEXICO, AUSTRALIA, NEW ZEALAND, IRAN, MALAYA, RHODESIA, UNION OF SOUTH AFRICA, CENTRAL, EAST AND WEST AFRICA, BELGIUM, FRANCE, GERMANY, HOLLAND, ITALY, SWITZERLAND

S JOHN PEARS
HENRY A BENSON, C.B.E.
WILLIAM P V COOPER
BRIAN W GRAVES
JOHN PERFECT
W EDMUND CASKELLEY
J FRANCIS SHEARER O.B.E.
ROBERT PHILP
RONALD F SUMNER
BRIAN A MAYNARD
DAVID C HOBSON
GRENVILLE C B GOLDEN-WITCHIN
B J DAVID COPSEY
T ANTHONY TANSLEY

PRINCIPAL MANAGER J P SMITH

TELEPHONE: MONARCH 4040
TELEGRAMS: COOPERS, LONDON.

ABACUS HOUSE,
33, GUTTER LANE,
CHEAPSIDE,
LONDON, E.C.2.

OUR REFERENCE

3rd June 1960

The Chairman,
Development Commission,
P.O. Box M.39,
Accra,
Ghana.

Dear Sir,

Volta River Project
Estimates of the Cost of the Hydro-Electric Project at Akosombo and the Ghana Transmission System

In accordance with the instructions in your letter of 5th February 1960 we have examined the estimates of the cost of the dam and power project at Akosombo and the Ghana transmission system, prepared by the Engineers' division of Henry J. Kaiser Company, in the same manner as we had previously examined the estimates of the former project at Ajena prepared by Sir William Halcrow and partners. The estimates examined relate to the capital and operating costs of the proposed dam and power house at Akosombo, the proposed transmission system to Tema and the proposed transmission system throughout Ghana, all of which are described in detail in Kaisers' Outline Design Report of January 1960.

2. This report is divided under seven main headings :

		Paragraphs
I	INTRODUCTION TO THE ESTIMATES	3 - 11
II	ESTIMATES EXAMINED	12 - 21
III	ESTIMATE OF THE CAPITAL COST OF THE MAIN WORKS AT AKOSOMBO	22 - 66
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I INTRODUCTION TO THE ESTIMATES

Previous Association with the Volta Project

3. Our early association with the Volta project was set out in our report to the Preparatory Commission dated 2nd November 1955 which related to our examination of the estimates of the capital and operating costs of the then proposed hydro-electric scheme at Ajena. The present scheme for Akosombo has much in common with the former Ajena scheme, particularly as

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regards the type of dam (rockfill), the methods of construction and the close association with a scheme for an aluminium smelter. The thorough investigations of the Preparatory Commission at that time and our detailed examination of the estimates of the Ajena project have been helpful in examining the estimates of the Akosombo project.

4. Since our work on the Ajena project in 1955 we have had experience of other major capital expenditure schemes. In particular, we have had the benefit of experience on the Kariba scheme in Rhodesia, the first stage of which is now completed, and in respect of which we acted in a similar capacity as for the Volta project.

Visits to Oakland, California and Ghana

5. In the course of our enquiries we visited Oakland, California, from 14th February to 4th March 1960 to examine the estimates in detail and to discuss them with Colonel Gerdes of the Engineers' division of Henry J. Kaiser Company and the members of his staff who are engaged in the design, planning and estimating of the project.

6. We also visited Ghana from 21st to 26th March 1960 for discussions with you and with the Volta River Secretariat, to obtain further information regarding construction costs in West Africa and to inform Colonel Gerdes, who was on a visit to Ghana, of the points on Kaisers' estimates on which we required his views and explanations. Colonel Gerdes noted these points and arranged to discuss them further with us in London.

7. The outcome of the discussions in London was that Colonel Gerdes agreed that the estimates required material adjustments and he instructed his staff in Oakland to re-compute them, giving effect to the matters we had put before him. He obtained your agreement that we should again attend at Oakland to examine the revised estimates; this visit was made from 18th April to 4th May 1960.

Second Visit to Oakland, California

8. During this second visit to Oakland we closely examined all the new information put before us and discussed it with Colonel Gerdes and his staff. Eventually we agreed that the revised estimates summarised in column (3) of paragraph 12 were reasonable for the first stage of the project on the basis of the present designs and the plans for construction. After we had reached this conclusion Mr John Hallet, vice-president of the heavy construction division of Henry J. Kaiser, said that he would not agree to the revised estimates and that he stood by the estimates in Kaisers' Outline Design Report of January 1960 (column (1) of paragraph 12), which, for reasons given to Kaisers in discussion and in writing we had considered to be substantially too low from their first presentation to us in detail.

Kaisers' Revised Estimates

9. Later, after we had left Oakland, Kaisers decided to revise the estimates in the Outline Design Report and the revised figures were given to us in London. They are set out in column (2) of paragraph 12. We asked for detail in support of them so that we might explain the differences between them and the estimates in columns (1) and (3) but, although detail was promised, none has yet been given to us. A letter dated 23rd May 1960 merely restated the total figures given to us three weeks earlier in London with broad explanations of the reasons for the revision. This report was delayed in expectation of more detailed information.

10. It will be seen from the table in paragraph 12 that Kaisers' revised estimates of the main works at Akosombo (item 7) are substantially higher than those in the Outline Design Report. They appear to meet some of the points raised by us with Colonel Gerdes in Accra, London and Oakland but we think they are still too low. In our opinion the estimates agreed by us as reasonable during our second visit to Oakland, summarised in column (3) of paragraph 12 should be adopted when considering the provision of finance for the project and when computing the cost of power.

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Basic Reasons for Kaisers' Estimates Being, In Our Opinion, Too Low

11. The detailed reasons for the opinion in the preceeding paragraph are given later in this report but there are two basic reasons for Kaisers' estimates being as, we consider, too low :

(a) In the estimates in the Outline Design Report, Kaisers attempted to arrive at a figure with which they would expect to win the contract for the project. This method would not normally arrive at a reliable estimate of the full cost of the project; substantial additional costs will inevitably be incurred which will be reimbursed to the contractors or others. Kaisers indicate that their revised figures are intended to meet this point. In their letter of 23rd May 1960 they say that the figures represent "a change in our viewpoint from that of presenting our contractor's bid price estimate to that of a conservative engineering estimate".

(b) Kaisers' estimates in the Outline Design Report are based on performances with men and machinery in West Africa equivalent to those which they would expect to obtain in the United States of America. This is against the experience of contractors, suppliers of construction equipment and others who have operated in West Africa, but we agree with Kaisers that, on a large project such as this, a contractor experienced in the construction of rockfill dams should obtain better performances than have generally been achieved in West Africa in the past. The figures agreed by us as reasonable (column (3) of paragraph 12) give due allowance for this factor but we think that Kaisers' estimates in the Outline Design Report (column (1) of paragraph 12) are based on performances which are unlikely to be maintained throughout the construction period. Also, although we have no details, it is probable that Kaisers' revised estimates (column (2) of paragraph 12) have not been sufficiently adjusted for the lower performances which are experienced in West Africa.

II ESTIMATES EXAMINED

Estimates of Capital Cost

12. The estimates of the capital cost of the first stage of the Akosombo project and the proposed Ghana transmission system, which you asked us to examine, are those set out in Volume II, Chapter XI, page 4 of Kaisers' Outline Design Report of January 1960; they amount to £60,787,000 and are summarised in column (1) of the table below. As explained in the preceeding paragraphs, as a result of our examination of these estimates, Kaisers now wish to substitute the estimates in column (2) below. The estimates of which we approve and which we agreed with Kaisers in Oakland but from which they later withdrew their support are summarised in column (3) below.

The Chairman,
Development Commission.

Item	Estimates of Capital Cost – First Stage: Outline Design Report January 1960 (1) £'000	Estimates of Capital Cost – First Stage: Kaisers' revision of estimates in Column (1) (2) £'000	Estimates of Capital Cost – First Stage: Estimates agreed by us as reasonable (3) £'000	Reference to this Report (4) Paragraph
Generation				
Main Works				
1. Housing, amenities and access roads	3,211	No	3,999	
2. Dam and power station	21,786	details	27,153	
3.	24,997	28,158	31,152	
4. Engineering	1,543	1,558	1,558	
5.	26,540	29,716	32,710	
6. Contingencies	5,246	6,541	6,541	
7.	31,786	36,257	39,251	22
Other Costs				
8. Compensation and resettlement	3,500	3,500	3,500	18
9. Volta River Authority	1,500	1,500	1,500	18
10. Lakeside health and maintenance	1,116	1,116	1,116	18
11. Other health expenditure	125	125	125	18
12. Volta River development	209	209	209	18
13.	38,236	42,707	45,701	
Interest at 5% per annum				
14. To 31st December 1965	4,400	6,497	7,786	63 to 66
15.	42,636	49,204	53,487	
16. Year ending 31st December 1966	1,321	-	2,672	63 to 66
17.	43,957	49,204	56,159	
18. Preliminary Surveys	1,307	1,307	1,307	18 and 19
19. Capital Cost of Works	45,264	50,511	57,466	
Transmission				
20. Akosombo to Tema	2,670	2,670	2,670	
21. Tema to smelter	950	950	950	
22. Ghana net	7,790	7,790	7,790	
23.	11,410	11,410	11,410	
24. Engineering	754	754	754	
25.	12,164	12,164	12,164	
26. Contingencies	2,480	2,480	2,480	
27.	14,644	14,644	14,644	
28. Interest during construction at 5% per annum	879	879	879	
29. Capital Cost of Transmission	15,523	15,523	15,523	67 to 71
30. Total Generation and Transmission	60,787	66,034	72,989	

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Basis of Estimates - Main Works

13. The estimates relate to the project described in detail in the four volumes of the Outline Design Report of January 1960. It will be seen from that report that the design of the main works at Akosombo is well advanced. During our last visit to Oakland we were informed that no major changes in design had been made since the report was issued and that none are contemplated as a result of the research and development so far carried out at Akosombo. The depth of the river at the dam site and the amount of sand to be dredged has created some technical problems but we were informed that these have been resolved and that no adjustment need be made on account of them. We understand that it has not yet been decided whether the saddle dam shall be an earth-fill or rock-fill construction but the estimates have been based on rock-fill which is generally considerably more expensive than earth-fill; they are therefore conservative in this respect.

14. Extensive investigations have been made of sand, rock, clay and other materials to be used in the construction of the dam and power house and Kaiser Engineers are satisfied that all the materials required in the construction are available in sufficient quantity and of suitable quality. Construction methods have been outlined, a construction programme has been drawn up and a list of the equipment which will be required for the construction has been prepared.

15. The information produced in the Outline Design Report has enabled the estimators to calculate quantities which, we were informed, have been calculated conservatively by adding about 5 per cent to the measured quantities. The estimates in the Outline Design Report (column (1) of paragraph 12) were prepared by evaluating these quantities by processes similar to those described in our report to you dated 2nd November 1955 on the former Ajena Project. The estimates in column (3) of paragraph 12 are those in column (1) together with the additions explained in paragraphs 22 to 66. These additions have not yet been absorbed in the cost of the individual items in the bills of quantities.

16. In our examination of the estimates we have followed your instructions to us when asking us to examine the estimates for the Ajena Project in which you "assumed that it would not be necessary to examine matters of an engineering or other technical character." Our examination was therefore directed to the values set against the measured quantities; all matters leading up to the bills of quantities including the measurement of the quantities were considered to be of a technical nature. These technical matters are the basis on which the estimates were made.

Basis of Estimates - Transmission System

17. The estimates of the cost of the transmission system are based on the routes and designs described in Chapter X of the Outline Design Report. We understand that the design of the transmission system to Tema is unlikely to be materially altered but the design, route and extent of the system throughout Ghana have yet to be decided and the route, when decided upon will need to be surveyed and explored. The estimates are however based on a transmission system which is unlikely to be exceeded in extent at this stage of development and, in total, are of a figure which should be adequate for any practicable system for Ghana at present.

Basis of Estimates - Other Costs and Preliminary Surveys

18. The amounts shown against items 8 to 11 and item 18 are identical with the amounts under the same headings in the estimates of the former Ajena project and which are set out on page 356 of volume 2 of the Preparatory Commission's report. These items were fully investigated by the Preparatory Commission and we understand that you consider the amounts to be adequate, in total, at the present time. We have not therefore examined these estimates on this occasion. We were not previously required by the Preparatory Commission to examine any of these items, except Lakeside Health and Maintenance and Other Health Expenditure.

19. You informed us that item 18, which amounts to £1,307,000 for preliminary surveys, will be written off. It remains in the estimates at present in order that the total estimated cost of the scheme should be available for financial considerations. When written off it will not incur interest and it has therefore been excluded from the calculation of interest during construction.

Date of Estimates

20. The estimates in the Outline Design Report of January 1960 (column (1) of paragraph 12) were based on prices ruling at 30th September 1959 together with a provision, in contingencies, for price increases before and during the construction. The estimates of which we approve (column (3) of paragraph 12) contain (in items 1 to 5) a provision for price increases up to 1st January 1961, when it is planned that bids should be received; a further provision for price and labour increases during construction is included in contingencies (item 6). The extent and the limitations of these provisions are explained in paragraphs 56, 60 and 61.

Estimates of Operating Costs

21. Kaisers' estimate of the cost of operating the power station and transmission system are set out in paragraph 77. They do not include depreciation, amortisation of loans or interest on loans, which are matters to be taken into account in ascertaining the cost of power. We have thought it advisable to defer reporting on the cost of power until there is more definite information on the terms on which money is to be provided to meet the cost of the project, the contract for power for the aluminium smelter, the Ghana load growth and the design and extent of the Ghana transmission system. Estimates of the cost of power can, at present, only be made on the basis of assumptions regarding these important matters. A report on the cost of power would therefore be of more value when more is known about them. The report now being prepared by the International Bank for Reconstruction and Development on power development in Ghana should assist in this respect.

III ESTIMATES OF THE CAPITAL COST OF THE MAIN WORKS AT AKOSOMBO

22. The estimates of the capital cost of the main works at Akosombo, exclusive of the items classified as other costs, preliminary [illegible] and interest during construction, are shown at item 7 in the table in paragraph 12. With the exception of interest during construction the differences between the original estimates in the Outline Design Report, Kaisers' later revision of those estimates and the estimates which appear to us as reasonable are contained in the figures shown against item 7. The table set out below classifies the expenditure under the various headings of cost and shows where the differences between the original estimates and those agreed by us as reasonable lie. We cannot make a detailed comparison with Kaisers' revised estimates because of lack of information as to the adjustments which they contain. The table is followed by explanations of the estimates and the reasons for our recommendation that the figures in column (3) should be used when considering the provision of finance for the project and when computing the cost of power.

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Cost Classification	Estimates of Capital Cost Main Works - First Stage: Estimates in Outline Design Report January 1960	Increases agreed by us	Estimates agreed by us as reasonable	Reference to this report
	(1)	(2)	(3)	(4)
	£'000	£'000	£'000	Paragraph
Housing and Access Roads				
Permanent housing	258	-	258	
Temporary housing and amenities	2,027	540	2,567	
Access roads	507	-	507	
	2,792	540	3,332	53 to 55
Materials and Plant Installed				
Materials incorporated in structure	2,159	-	2,159	39
Turbines and generators	3,578	-	3,578	41 to 43
Other plant	1,063	-	1,063	40
	6,800	-	6,800	
Construction and Installation				
Labour				
Direct	1,028	2,685	3,713	
Supervision, engineering and instruction	1,244	160	1,404	
Offices, purchasing, stores and miscellaneous	615	313	928	
	2,887	3,158	6,045	24 to 37
Supplies	4,348	-	4,348	38
Construction plant and equipment	3,438	-	3,438	44 and 45
Other expenses	1,472	471	1,943	46 to 52
	12,145	3,629	15,774	
Total	21,737	4,169	25,906	
Provision for increases in prices to 31st December 1960	-	501	501	56
	21,737	4,670	26,407	
Contractors' profit, interest and general overheads	3,260	1,485	4,745	58
	24,997	6,155	31,152	
Engineers' fees and expenses	1,543	15	1,558	57
	26,540	6,170	32,710	
Contingencies, including increases in prices and labour rates during construction	5,246	1,295	6,541	59 to 62
Total (item 7 of paragraph 12)	31,786	7,465	39,251	

23. The principal assumptions made in the original estimates and the estimates agreed by us as reasonable are :

(a) That there will be only one main contractor, although he may let some or all of the work to sub-contractors if he should so wish.

(b) That the main contractor will be one of the large contractors with international experience and that Europeans or European sub-contractors will be employed to supervise or carry out much of the work with Ghanian skilled and unskilled assistance.

(c) That the maximum use will be made of modern equipment.

(d) That there will be no restrictions on the employment of Americans, Europeans or others.

(e) That there will be no restrictions on the import of machinery, materials or suppliers of any nature and that such imports will not be subject to import duty.

Labour

24. The greater part of the difference between the original estimates and those agreed by us as reasonable originates from the estimates of labour, a more detailed analysis of which is set out below :-

	Labour Estimates Main Works - First Stage		
	Outline Design Report	Increases agreed by us	Estimates agreed by us as reasonable
	(1)	(2)	(3)
	£'000	£'000	£'000
Direct Labour			
European	328	885	1,213
African	700	1,800	2,500
	1,028	2,685	3,713
Supervision, Engineering and Instruction			
American	621	-	621
European	495	120	615
African	128	40	168
	1,244	160	1,404
Offices, Purchasing, Stores and Miscellaneous			
American	71	-	71
European	317	88	405
African	227	225	452
	615	313	928
Total			
American	692	-	692
European	1,140	1,093	2,233
African	1,055	2,065	3,120
	2,887	3,158	6,045

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25. The amounts shown above include provisions for many payments or benefits to employees other than payment for work directly on the contract, such as :-

(a) Holiday pay within Ghana.

(b) Expatriate leave pay.

(c) Recruitment including payments for time from engagement to start of work on the site.

(d) Payments during instruction or training.

(e) Payments from the end of employment at the site to the end of employment contracts.

(f) Compensation, idle time or other non-productive payments.

(g) The cost of dismissing unsatisfactory employees and obtaining replacements.

(h) Contract completion bonuses or any incentives of that nature.

(i) Car, outfit, education and any other benefits, other than housing and travelling, which may be included in the contracts of employment.

Travelling expenses on taking up or relinquishing employment or going on leave and returning therefrom are not included in the labour costs but are taken into account in indirect expenses (paragraph 46).

26. The reasons for the substantial increases in the estimates of labour shown in paragraph 24 were, in the main, set out in notes given to Kaisers after our visit to Ghana in March 1960. They are explained in the paragraphs which follow.

Labour Force

27. The size of the labour force which is represented by the estimates set out in paragraph 24 can conveniently be expressed in man-years for the purpose of overall consideration. The approximate number of man-years in each category is set out below. It will be noted that the man-years do not increase in the same proportion as the amounts in the estimates; this is principally because the increases in the estimates contain provisions for increased remuneration and benefits in addition to increases in the number of man-years.

Approximate Man-Years in Labour Estimates of Main Works - First Stage		
Outline Design Report	Increases agreed by us	Estimates agreed by us as reasonable
(1)	(2)	(3)
man-years	man-years	man-years
Direct Labour		
European	250	350	600
African	4,000	6,000	10,000
	4,250	6,350	10,600
Supervision, Engineering and Instruction			
American	100	-	100
European	200	-	200
African	200	-	200
	500	-	500
Offices, Purchasing, Stores and Miscellaneous			
American	20	-	20
European	150	-	150
African	650	250	900
	820	250	1,070
Total			
American	120	-	120
European	600	350	950
African	4,850	6,250	11,100
	5,570	6,600	12,170

28. Although the estimates in the Outline Design Report contain remuneration for only 5,570 man-years of all grades of labour, the estimate of man-power at the end of section XI of that report envisages a much larger labour force, reaching a maximum strength of 5,500 men of all grades and amounting to about 16,000 man-years over the construction period at Akosombo. From our detailed examination of the estimates we concluded that both the estimated cost of labour and the estimated labour requirements were wrong, the former being too low and the latter too high. The principal figure relates to African direct labour for which only 4,000 man-years had been provided in the estimates. After discussion with Colonel Gerdes and his staff we agreed that it would be reasonable to add 6,000 man-years for African direct labour. The addition of 250 man-years to the estimate of African indirect labour provides for teachers, firemen, mess staff, camp maintenance staff and others omitted from the original estimates.

29. The addition of 350 man-years of European direct labour provides for 72 equipment operators and 100 additional foremen. There were no European equipment operators in the original estimates and the number of foremen was much too low for the three shift working on which the estimates have been calculated. Nevertheless the machine performances assumed in the estimates were equal to those expected under good conditions in America. Colonel Gerdes agreed that the estimates should provide for experienced European operators for the heavy equipment, such as power shovels and cranes, and more European foremen for the close supervision which will be necessary to achieve a high output rate.

Comparisons with Labour Force on Other Projects

30. In considering the labour force required we were able to make useful comparisons with the estimates of the former Ajena project which provided for more than 20,000 man-years of all classes of labour. The Akosombo project is designed to be more economical in construction than the Ajena project and a lower labour cost can be expected. The development of the design and use of powerful constructional equipment has advanced considerably during the last five years and for this reason also the labour cost should be lower. In addition the estimates agreed by us as reasonable provide for more European operators, foremen and supervision than was provided in the estimates of the former Ajena project. For these reasons the amount of African labour required on the Akosombo project is likely to be less than that estimated to be required for the former Ajena project.

31. The labour employed on the Kariba project also provides a useful general guide to the amount of labour which might be required on the Volta project. The annual report of the Federal Power Board for the year ended 30th June 1959 shows, on page 34, that about 22,000 man-years of African labour were required on the dam and power project in addition to about 4,000 man-years of European labour, many more than are estimated to be required for Akosombo. The difference between the two projects in terms of estimated cost is small but the Kariba dam, being of concrete, and the power house, being underground, would require much more labour than the rockfill dam and power house at Akosombo.

32. Using the comparisons with the former estimates for the Ajena project and the actual experience on the Kariba contract we think that it is reasonable to expect the amount of African direct and indirect labour to approximate to 11,000 man-years and European direct and indirect labour to approximate to 1,000 man-years and that to estimate for a lower labour requirement than this would be dangerous. Broadly, this would imply a maximum labour force of about 3,500 over a period of about two years, with considerably lower numbers over the other two and a half years of construction.

33. Our views on African labour requirements are supported by a considerable amount of information obtained from contractors, equipment suppliers and others with operational experience of West Africa. We also noted that the contractors on the preliminary works now being carried out have for some time employed over 1,500 Africans on these works.

Remuneration and Benefits - African

34. The original estimates of the cost of African labour used basic labour rates supplied by the Public Works Department. These were daily rates and Kaisers computed their estimates by applying these rates to eight hour shifts with no additional allowances for night shifts or incentive. Our discussions with contractors and others with experience of Ghana showed that this method of estimating would not reflect the actual cost of African labour when applied to the output which Kaisers were expecting in their estimates. Either the estimated output from each shift should be reduced or the labour rates should be increased to obtain the output expected.

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35. We understand that many employers in West Africa either pay the daily rate for a day of less than eight hours or expect to get less than the equivalent of eight hours work; others pay incentives in the form of a rate for the job, a bonus or overtime. After considering all the information at our disposal we thought that this point would be met by adding approximately 50% to the amount provided for African labour in the estimates.

Remuneration and Benefits - European

36. The original estimates computed European labour of the foremen grade at £4. 2. 0 per shift of eight hours, day or night. This would enable a man to earn about £1,100 a year and would be unlikely to attract the type of man who could ensure the high rates of output on which the estimates are based. The rates of most of the other European employees were also too low. We pointed out to Kaisers that, on account of the high cost of getting men to and from the site, housing them, providing them with the amenities they will require and paying them during their leave it was necessary to attract capable and experienced men and it was therefore essential to offer good remuneration. The estimates agreed by us as reasonable provide for an increase in the earnings of foremen and operators to about £1,500 a year with corresponding increases in other grades.

37. The original estimates provided for only two weeks holiday per annum for the Europeans in the direct labour category and the tours assumed for other Europeans were too long by present day standards. The estimates agreed by us as reasonable now provide three months leave for all Europeans after fifteen months in Ghana. It should perhaps be pointed out that this is a basis for estimating. In practice it will be impossible for all tours to be arranged on this basis.

Supplies £4,348,000

38. The main items in this figure are tyres, fuel and spares for the constructional plant and equipment and bits and explosives for drilling. We were able to confirm that the estimate for tyres, fuel and spares were adequate by reference to the equipment manufacturers' handbooks. The estimate of the consumption of bits and explosives is a technical matter and depends on the type of rock being broken and the skill of the operatives. The amounts provided were compared with estimates made by Kaisers of other projects in which the conditions were said to be somewhat similar and on the basis of this comparison appeared to be adequate.

Materials Incorporated in the Structure £2,159,000

Other Plant £1,063,000

39. The principal materials incorporated in the structure are structural and reinforcing steel and cement. The prices at which they have been evaluated are derived from quotations for the commodities delivered to the site.

40. Other plant comprises all plant in the dam and power house other than turbines and generators. The main items are penstocks, cranes, gates, trashracks and power house equipment. The amounts in the estimates are all based on quotations from European suppliers. We have examined the quotations and the estimates have been properly computed from them.

Turbines and Generators £3,578,000

41. Quotations were obtained from many suppliers of turbines and generators, the most promising ones being selected for closer examination. One of the two lowest quotations was selected as the quotation on which to base the estimate of turbines. The supplier is N.O.M.A.B. at a delivered price of £1,202,000 for four units with a rated output of 126,500 K.W. each. This amount does not include the cost of installation which is estimated at £641,000 and is included in the estimate of the main contract.

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42. The quotation selected for the estimate of the cost of the generators was made by English Electric Limited and amounted to £2,376,000 for four units delivered to the site plus installation costs of £264,000. This quotation was the second highest and was considerably higher than two lower quotations. We understand that it was selected as technically the most suitable.

43. Taken together we think that the estimates for the turbines and generators are reasonable. Although the lowest quotation was taken for the turbines, two suppliers quoted the same price and a third, English Electric Limited, was only slightly higher. In addition, the selection of one of the higher quotations for the generators ensures that the combined estimate is not under stated.

Construction Plant and Euipment £3,438,000

44. The estimate for this item has been prepared with considerable care. The price, performance and other characteristics of the equipment required to move and place a large volume of rock, clay and other material were closely studied by Kaisers who have accumulated much information and experience of this type of equipment. The equipment selected for the purpose of the estimates was supported by quotations from suppliers and by quotations for competitive equipment. We are satisfied that the estimate is adequate.

45. The estimates assume that only new equipment will be used on the project and that there will be no residual value. This is a conservative approach which is usual on contracts of this type and one which we have taken into account when considering the estimates as a whole, in particular when assessing the adequacy of the provision for contractors' profit.

Other Expenses £1,943,000

46. This amount broadly consists of :-

Item	Outline Design Report	Increases agreed by us	Estimates agreed by us as reasonable
	(1)	(2)	(3)
	£'000	£'000	£'000
Travel of expatriate staff	277	203	480
Travelling expenses of home office personnel	52	48	100
Maintenance of roads, buildings and camp	234	-	234
Bond premiums	60	-	60
Fire, flood and other insurance	262	-	262
Sick pay for Africans	-	150	150
Mess hall operation and free food for Africans	334	-	334
Miscellaneous expenses	253	70	323
	1,472	471	1,943

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Travelling Expenses of Expatriates £480,000

47. The additional amount of £203,000 for the travel of expatriate staff provides for the expenses of the additional operators and foremen (paragraph 29), the extra travel occasioned by the shorter tours (paragraph 37), and the travel of the foremen which had been omitted from the original estimates. Travelling expenses are provided for all families brought to the site.

Travelling Expenses of Home Office Personnel £100,000

48. The amount of travelling by home office personnel (that is those not regularly employed on the site) depends on the amount of supervision which the contractor considers to be necessary from his head office. It is inevitable, in a contract of this nature, that there should be a considerable amount of travel and the provision was therefore raised to £100,000.

Bond Premiums £60,000

49. This provides for a bond in a penalty of $5,000,000 at a premium of ¾% per annum. Because of the magnitude of the project Kaisers do not think it would be possible to furnish a bond at 100% or even 50% of project value; the premium would be high and the protection given would, in their opinion, be unnecessary. They think also that a $5,000,000 penalty may be excessive but point out that the amount is for the decision of the client.

Fire, Flood and Other Insurance £262,000

50. Kaisers undertook to obtain further information from their brokers regarding this amount which originally represented a figure much too high for fire insurance and too low for flood insurance. We have not yet been given a revised calculation or any information from the insurance brokers. The cost of flood insurance will depend on the nature of the insurance policy and the extent to which the owner decides to insure the works. This will probably not be determined for some time, and it may prove difficult to obtain insurance at reasonable rates. This is a matter on which we think you should attempt to obtain some clarification as soon as possible; you may wish to take up the question of the amount of the bond premium at the same time. The views of the possible providers of finance for the project should be obtained because their terms may include stipulations on these matters.

Sick Pay for Africans £150,000

51. This amount was added to the estimates by Kaisers on the advice of their manager in Ghana who said it was probable that legislation regarding sick pay would be introduced in the near future. It is a general provision because the terms of the possible legislation are not known.

Mess Hall Operation and Free Food for Africans £334,000

52. This amount covers the deficit which it is expected will arise on the running of the European mess and the provision of some free rations for Africans. The cost of the mess buildings is included in housing and amenities and the cost of mess labour in labour.

Housing, Amenities and Access Roads £3,332,000

53. Contracts for the permanent housing, access roads and some temporary housing have already been placed and the work is well advanced. The permanent housing will be occupied by the construction staff in the first instance.

54. The estimate covers housing for all American and European staff, assuming that half of them bring their families to the site. It also provides quarters for all African foremen and for 2,000 other African employees. The contractor will be expected to provide any additional housing he may require, but Kaisers do not think any will be necessary because it should be possible to recruit any additional African labour locally. The labour force of over 1,500 on the preliminary contracts at present being carried out is recruited locally without the provision of any accommodation.

55. The increase of £540,000 in the estimate for temporary housing is mainly due to the increase in the European labour force. It also takes into account houses for the engineering staff and others omitted from the earlier estimates and covers the cost of a number of amenities which will be necessary.

Provision for Price Increases to 31st December 1960 £501,000

56. The original estimates were prepared on prices ruling at about 30th September 1959. There have been some minor price increases since that date, notably in the prices of constructional equipment. Kaisers therefore agreed to increase the estimates of supplies, materials and plant and equipment by 5% to guard against increases which might be made before 1st January 1960 when it is planned that bids should be received. They did not think that any provision would be necessary in the case of turbines and generators but they were making enquiries; we have not yet heard the result and no provision has been made. As regards labour, we think the increases which we have made in the rates of remuneration are sufficient to cover any general increase in the cost of labour before 31st December 1960. Possible increases in prices and labour rates during construction are included in contingencies (paragraph 60).

Engineers' Fees and Expenses £1,558,000

57. This amount is calculated at 5% on the cost of the construction and installation. On this basis, it is slightly in excess of the amount in the estimates in the Outline Design Report which was calculated from the proposal put to the Development Commission by Kaisers on 3rd December 1959. This proposal suggested a fixed fee for the whole project, including the transmission system, of £400,000 together with all expenses which were defined in detail in the proposal. We understand that you have already accepted the proposal insofar as it relates to the preparation of contract plant and specifications in complete form for the receipt of tenders for competitive bids on a firm price basis.

Contractors' Profit, Interest and General Overheads £4,745,000

58. Paragraphs 36 to 38 of our report dated 2nd November 1955 to the Preparatory Commission set out the considerations which a contractor would take into account when estimating this item. It has been calculated at 20% on the total cost of the works except turbines and generators on which 5% has been taken. The amount is in our opinion adequate having regard to the adjustments made to the original estimates, provided that substantial advances are made to the contractor against his purchases of plant and supplies. Colonel Gerdes informed us that he would write advances of 75% of the cost of plant and supplies into the draft contract. We have assumed that these advances would be made when calculating interest during construction. Part of the contractors' remuneration might be paid as a bonus for completion of the contract within a specific time limit or as a series of bonuses for completion of specific stages.

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Contingencies £6,541,000

59. This amount has been calculated at 20% of the total cost of the works at Akosombo. It is intended to cover all unforeseen costs resulting from such causes as :-

(a) Undetected engineering difficulties.

(b) Labour troubles such as recruiting difficulties, shortage at critical times, unexpectedly high rates of sickness and absenteeism, excessive turnover and strikes.

(c) Unexpected difficulties with materials.

(d) Delays in delivering imported materials or plant.

(e) Damage caused by flood or other hazard other than anything very exceptional and not covered by insurance.

(f) Errors or omissions in the bills of quantities.

(g) Increases in prices and labour costs to the extent described in the next paragraph.

The provision does not cover such items as :-

(a) Major alterations to the design of the project.

(b) The addition of features, for example a more elaborate power house, additional roads over and around the dam, additions to the permanent township and landscaping.

(c) The effect of providing more compensation water during construction if this should be found necessary.

(d) Bush clearance, if this should be found to be necessary on any scale.

(e) The effect of loss of water to irrigation or other schemes in Ghana or in adjoining territories.

60. In arriving at the rate of 20%, 15% was included for all contingencies except increases in prices and labour rates for which 5% was added but we do not think that this segregation should be made. The whole amount should be considered as available for all contingencies without specifying amounts for any particular contingency. As regards prices and labour rates, the contingencies provision is intended only to cover increases on the moderate scale experienced during the last three years in the United Kingdom and other principal European countries which can be expected to supply the bulk of the expatriate staff, plant and supplies. There is no provision in the estimates for increases in prices and labour on a scale greater than this and this is a point which should always be taken into account in financial considerations.

61. Although the possibility of a high rate of inflation must be considered we think that, if it does not occur until the construction is well under way, its effect may not be serious. The American and European labour will have been contracted for the first tours, possibly longer, and the construction plant, together with much of the supplies, will have been purchased. The housing and access roads will also have been completed. These factors would reduce the effects of inflation on the cost of the project.

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62. The additional interest which would be incurred by the loss of a year due to slow filling of the lake or any other cause is not included in the provision for contingencies but is provided separately to the extent explained in paragraph 64.

Interest

63. Interest during construction has been calculated at 5% per annum. This rate is used as a guide only to the cost of interest, the actual cost of which will depend on the terms on which the scheme will be financed. It has been calculated on the total cost of the project, except preliminary surveys, on the basis of a cash forecast prepared by Kaisers which assumes that 75% interest free advances will be paid to the contractor on the purchase of construction plant and supplies. It has been compounded with half yearly rests. The effect of interest at 5%, 5½% and 6% would be :-

	Rate of interest per annum		
	5%	5½%	6%
	£'000	£'000	£'000
Interest to 31st December 1965	7,786	8,643	9,608
Interest for year ending 31st December 1966	2,672	2,989	3,218
	10,458	11,632	12,826

64. In the first place, interest has been provided to 31st December 1965, by which time it is planned that some power would be available to start up the generators and the smelter plant, but power for full production would not be available until the flood of 1966 which would have passed in about October. Records over a period of 25 years show that this programme will be possible if average river flow conditions are experienced over the two years of lake filling but it would not be possible under many combinations of two years' river flow during the 25 year period. In this event there would be no power for sale and a further year's interest would be incurred. Kaisers recognised this risk by providing interest for an additional year in the estimates in the Outline Design Report (paragraph 5 of Chapter XI) and provision has again been made on the estimates approved by us (item 16 of paragraph 12).

65. The first year of operation will, in any event, be one in which only a small amount of power will be available. Mr Calhoun, vice-president of Henry J. Kaiser Company, assured us that the smelter would be built in time to take power at the earliest date planned for first power but the heads of agreement between Valco and the Ghana government do not indicate the amount of revenue which will be contributed by the smelter. However Mr Calhoun informed us that it was intended that Valco would only pay for power available. If, therefore, full power is not available in the early years the possibility of large deficits must be expected.

66. The uncertainties regarding when first power will be available, how much will be available and how much revenue will be earned by the power available are important matters in considering the finances of the project. Kaisers should explain and assess the possibilities of the lake filling slowly and the amount of power which will be available for sale under various assumptions regarding lake filling. Also, Valco should indicate the amount they will pay, or the basis on which they will pay, for the relatively small amount of power available to them in the first years of power and possibly for later years if the two or three filling years are followed by low flow years such as 1958. For these contingencies, the estimates agreed by us as reasonable provide only for one additional year's interest. They do not provide for any deficiencies which may occur on operations when insufficient power is available or for operating costs, other than interest, during the additional year which may be required for filling.

IV ESTIMATE OF THE CAPITAL COST OF THE TRANSMISSION SYSTEM

Transmission System

67. The proposed transmission system is described in Chapter X of the Outline Design Report of January 1960. It would serve the proposed aluminium smelter at Tema and most of Southern Ghana. The main transmission covers over 400 miles and is designed at 161 K.V. It is combined with a subsidiary 69 K.V. system of about 300 miles. Transmitted power will be delivered at 11 K.V. at the primary sub-stations for local distribution or industrial use. The estimates do not provide for the cost of distribution from these sub-stations.

68. The system proposed by Kaisers is extensive and we understand that it was put forward in this way so that the maximum use which might be made of Volta Power could be considered. The estimates therefore relate to a system which is probably more extensive than any which will be embarked upon in the near future.

69. The estimates are of a preliminary nature because the extent and design of the system have not yet been decided upon. Kaisers have made studies of the relative economy of types of poles, towers, conductors and other equipment and have made preliminary selections for the purpose of the estimates. The proposed route of the system has not been fully surveyed or explored. It is known that part of the route runs through difficult country where bush clearance and site preparation would be expensive. Kaisers' Outline Design Report explains that the construction cost will be estimated at the completion of contract plans and specifications.

70. We understand that a report on future power development in Ghana is being written by the International Bank for Reconstruction and Development and will shortly be available. This should make it possible to decide on the extent of the system to be served by the Volta River Project and to proceed to final designs, surveys and estimation of cost. In the meantime the estimates provide a figure for an extensive system and we are satisfied that the figure is a reasonable one for preliminary consideration of a Ghana transmission system. The estimates have been prepared in some detail and the estimated cost of equipment is supported by quotations from reliable suppliers.

71. In view of the preliminary nature of the estimates we think that the amount of £15,523,000 should be looked upon as a figure which would probably provide any practicable transmission system for Ghana at the present time, excluding the cost of local distribution. The detailed composition of the estimate will not be of much consequence until the system is finalised but the figures set out below divide the estimate in a manner which will be helpful when considering the cost of power and its selling price:-

Section	Cost	Contingencies and Engineering	Interest	Total
	£'000	£'000	£'000	£'000
Akosombo to Tema	3,484	983	267	4,734
Tema to Smelter	636	181	49	866
Tema to Accra	759	217	59	1,035
Remainder of 161 K.V. system	5,085	1,442	392	6,919
69 K.V. system	1,446	411	112	1,969
	11,410	3,234	879	15,523

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The comments in paragraphs 57 to 62 regarding engineering and contingencies (which includes a provision for increases in prices and labour rates similar to that for the main works) apply also to the amount of £3,234,000 above. The provision for interest assumes a construction period of 32 months to the date when power is available. It does not contain a provision against slow filling of the lake.

V FINANCIAL CONSIDERATIONS

Possibility That Estimates May be Exceeded

72. We are satisfied that the estimates in column (3) of paragraph 12 are reasonable for this stage of the development of the project but it must be recognised that the risk of exceeding the estimates even by a substantial margin is not one which can be removed from a scheme of this kind. The adequacy or otherwise of the estimates will be more apparent when tenders have been received. The tenders should be lower than the estimates because the estimates should cover any sums payable to the contractors for claims and for changes in designs other than those of an exceptional nature. If there should not be a substantial margin between the estimates and the accepted tender it can be expected that the cost of the project will exceed the estimates.

Provision for Interest During Construction

73. Paragraphs 63 to 66 explain the basis of the calculations of interest during construction. The figures given are guides only and are not estimates of the probable cost of interest during construction. Reliable estimates of the cost of interest cannot be made until the terms on which money will be made available are known. Commitment charges will probably be incurred on amounts made available; the estimates do not contain any provision for such charges.

Expenditure Abroad

74. Kaisers have not prepared an estimate of the amounts which will be expended within Ghana and abroad. Broadly, we think that about 20% of the total expenditure, excluding interest, will be made directly to Ghanian employees and suppliers and 80% to expatriates and suppliers abroad but a substantial proportion of the expatriate employees earnings will be expended in Ghana.

Working Capital

75. The estimates do not provide for the working capital which will be required when the scheme is completed. Kaisers estimate that about £2,200,000 will be required (in their power cost allocation studies of 28th January 1960). This should be more than adequate if the project is in profitable operation from the time of first power, but may be inadequate if, for any reason, deficits are incurred in the early years of operation. The provision of working capital must be taken into account when considering the amount of finance which will be required for the project.

Insurance

76. The amount provided in the estimates for bond premium and insurance is explained in paragraphs 49 and 50 where we suggest that the amount of cover required should be considered now. We think that negotiations with brokers should be opened as soon as possible. The premiums for flood insurance may be high and some cover, such as consequential loss, may be unobtainable. As pointed out in paragraph 50 the insurance requirements of possible lenders of money for the project should be enquired into.

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VI ESTIMATE OF OPERATING COSTS

77. Kaisers' estimate of the annual cost of operating the power plant at Akosombo and the transmission system are set out in their power cost allocation studies of January 1960. The estimates, exclusive of interest, amortisation of loans or depreciation, are summarised below.

	Annual Operating Costs First Stage			
	Akosombo Works	Ghana Transmission	Smelter Transmission	Total
	£'000	£'000	£'000	£'000
Operation and maintenance	183	113	28	324
Administration	37	34	9	80
Interim replacements	127	24	6	157
	347	171	43	561
Volta River Authority :				
Administration	100	-	-	100
Lakeside health and sanitation	135	-	-	135
	582	171	43	796

78. The estimates are supported by detailed manning schedules and by comparisons with the actual operating costs of a number of other hydro-electric projects. We also made comparisons with other projects and we are satisfied that the estimates are reasonable. They are based on prices and labour rates ruling at the present time without any provision for increases which might be expected before the project comes into operation. The means by which the Volta River Authority will protect itself against rising prices and labour rates is a matter to be taken into account when negotiating contracts for the sale of power.

79. The estimate for interim replacements is intended to provide for major replacements of parts or equipment which are not taken into account in the estimate for operation and maintenance. This item is not a substitute for depreciation which is not included in the estimate above but which together with interest will be provided when computing the cost of power.

80. The figures for the Volta River Authority are identical with those in the Preparatory Commission's Report and have not been re-examined on this occasion.

The Chairman,
Development Commission.

VII CONCLUSION

81. The estimates of the capital cost of the Akosombo project and the Ghana transmission system set out in the Outline Design Report amounting to £60,787,000 are too low and as a result of our examination of the estimate Kaisers have submitted revised estimates amounting to £66,034,000. We have not had an opportunity of examining these revised estimates in detail but we think that they also are too low. In our opinion the estimates agreed by us as reasonable in Oakland, California amounting to £72,989,000 should be adopted when considering the provision of finance for the project but the matters summarised below should also be taken into account :

	Paragraphs
The principal assumptions on which the estimates are based	23
The amount of cover which will be required in the form of bond premiums and insurance against flood and other risks	49, 50 and 76
The items which are not covered by the provision for contingencies or otherwise included in the estimates	59
The limited extent of the provisions for increases in prices and labour rates	56, 60 and 61
The uncertainties regarding the time when first power will be available and the amount of power which will become available; the limited extent to which the estimates provide against these uncertainties	63 to 66
The preliminary nature of the estimates for the transmission system	69 to 71
The risk of exceeding the estimates cannot be removed from a scheme of this kind	72
The amounts included in the estimates for interest are not estimates of the probable cost of interest, but merely guides to the effect of interest during construction	73
The estimates of capital cost do not include anything for the working capital which will be required when the project becomes operational	75

82. If you should require any further information on matters in this report we shall endeavour to supply it,

We are, Dear Sir,
Yours truly,

COOPER BROTHERS & CO.

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